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REPORT

of

The Infantry Board

No. 1867

ROCKET, HIGH VELOCITY, 2.36", T-59

FORT BENNING, GEORGIA

19 SEP 1945

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1867

GNBCG 471.6 4 September 1947

SUBJECT: Rocket, HEAT, 2.36", T59E3; Rocket, Practice, 2.36", T60E2, and Fuze, Rocket, PD, T200OE1

THROUGH: Commanding General, The Infantry Center
Fort Benning, Georgia

TO: Commanding General, Army Ground Forces
Fort Monroe, Virginia
ATTN: GNDEV-11

1. References:

a. Infantry Board Report No. 1867, which strongly recommended standardization of the T59 rocket with minor modifications.

b. Report of The Infantry Conference "Committee A" on Tactics and Technique, June 1946, which concluded that the 2.36" rocket launcher, firing rockets of the T59 type provides a highly effective weapon for both offensive and defensive missions.

c. OCM #30829 which recorded the status of development of the T59 series 2.36" rockets, stating that satisfactory progress was being made at that time.

d. OCM #31487 which recorded the initiation of development of a new type weapon to replace the 2.36" and 3.5" rockets and the 57-mm recoilless rifle (a long range project).

2. Comparative data, M6A3 rocket and T59 rocket (2.36").

a. Penetration of armor.

(1) M6A3 - 4 inches.

(2) T59 - 7 inches.

b. Accuracy.

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(1) Three rounds at 100 yards.

	Lateral Spread feet	Vertical Spread feet
M6A3	.5	1.0
T59	.35	.25

(2) Three rounds at 300 yards.

	Lateral Spread feet	Vertical Spread feet
M6A3	1.0	6.1
T59	.95	1.0

(3) Three rounds at 500 yards.

	Lateral Spread feet	Vertical Spread feet
M6A3	20.4	30.
T59	1.75	2.9

c. Muzzle Velocity.

M6A3	270 ft/sec
T59	405 ft/sec

d. Maximum Range.

M6A3	700 yards
T59	1350 yards

e. Weight.

M6A3	3.4 pounds
T59	6.8 pounds

3. Pertinent portions of the conclusions of The Infantry Board contained in reference 1a, above, are quoted:

"7. Conclusions. The Infantry Board concludes:

"a. That there is an urgent military requirement for a high-velocity, long-range, 2.36" Rocket for use by foot-troops.

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"b. That the subject Rocket, High Velocity, 2.36", T-59, is defective only in that it is unreliable and ineffective on grazing impact.

"c. That, when modified so as to insure functioning of the fuze on grazing impact, (and assuring satisfactory armor penetration) the subject Rocket, High Velocity, 2.36", T-59 will be highly satisfactory and desirable for adoption as replacement for one-half the present, standard 2.36" Rocket, M6A3, in Infantry rifle companies and other units with similar combat missions, as complementary to a similar number of 3.5" Rockets and its launchers.

****

"f. That the closure of the propellant chamber of the subject rocket is inadequately waterproof."

4. Pertinent portions of the conclusions of Committee "A" on Tactics and Technique, The Infantry Conference, contained in reference 1b, above, are quoted:

"1. a. The 2.36" rocket launcher, firing rockets of the T-59 type, provides a highly effective offensive weapon for destruction of point targets at ranges up to 500 yards and is an effective defensive weapon against tanks with light and medium armor as now known. It should therefore, for the present, be retained as a weapon of the most forward infantry elements where a premium must be placed on weight of both weapon and ammunition.

****

"2. a. *******

"b. In rocket projectiles maximum performance should be the criterion, rather than specific limits as to size and weight. However, in general, the 2.36" and 3.5" projectiles should not exceed 5 and 10 pounds respectively. Ballistically, the projectile should travel with a minimum of yaw and with the flattest obtainable trajectory. Velocity should be as high as attainable with a minimum of flash and proper performance of the fuze and charge at the point of impact. Accuracy at ranges up to 500 yards should outweigh any prescribed maximum range.

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"3. If the 2.36" rocket of the T-59 type can be mass produced, and if the 3.5" rocket can be improved to have similar ballistic characteristics, they can replace recoilless weapons on normal missions at ranges up to 500 yards.

"4. Ammunition for employment against armor, fortifications, and personnel, and for incendiary and screening purposes, is required for both the 2.36" and 3.5" rocket launchers ##########. The ammunition developed for each type of weapon should have identical ballistic qualities.
"##########"

5. Information contained in OCM #30629, 18 July 1946, reference 1c, above, is as follows:

"2. a. Infantry Board tests and recommendations as recorded in OCM Item 30148 resulted in a redesign of the motor for the T59 round. No authorization had been given to start production of the T59E1 Rocket Motor as two additional designs, T59E2 and T59E3, had been made. The motor for the T59E2 design was made by drawing a cup and screwing the nozzle into the motor.

"b. The T59E3 design has threads on the large end for assembling to the head and the nozzle made integral with the chamber. A high alloy motor chamber without heat treatment or a minimum of heat treatment will be used. It is also planned to use stick propellant, thin web, M7, composition. An initial group of twenty (20) rounds is being made at Frankford Arsenal. Upon completion of tests of these rounds, it is planned to procure a pilot lot of one thousand (1000) rounds. The redesigned rounds have been designated:

"Rocket, HE, AT, 2.36-Inch, T59E3 and
"Rocket, Practice, 2.36-Inch, T60E3.

"c. Since the T59E1 and T59E2 Rockets appear less feasible for production than the T59E3 Rocket, and no pilot models had been procured, development on them has stopped.

"d. Fuze, Rocket, PD, T2000, among others, was placed under development to provide a fuze for the T59 Rocket. After tests at the Infantry Board, a redesign of the nose of the fuze was effected in order to provide a construction to give functioning on graze impact. This fuze as modified with the plastic nose projection, has been given the designation:

Fuze, Rocket, PD, T2000E1."

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6. Reference 1d, above, gives the approved military characteristics and a statement of the design problem involved for new weapon to be developed as a replacement for the 2.36" launcher and rocket, 3.5" launcher and rocket and 57mm recoilless rifle. It has this to say about the project:

> "A preliminary review of the project indicates that this evaluation study may be complex and extensive since no presently envisioned modification of any of the weapons to be replaced will meet the specified objectives."

7. The latest information available to this Board is to the effect that the entire project for the development of the T59 series rockets is to be cancelled. A continuing study of the military characteristics of the rocket launchers and recoilless weapon by this Board has brought to light no reason for terminating the development of the T59 series rocket. On the other hand, pending satisfactory progress in the development of the new weapon discussed in reference "1b" a more effective rocket for the 2.36" must, in the opinion of this Board, be sought to afford the infantry platoon and company a better defense against armor and better effect against strong defensive works. As previously stated by this Board in its Report of Test No. 1867, the T59 series rockets showed high promise of meeting this requirement.

8. It is therefore recommended that the development of the Rocket, HEAT, 2.36 inch, T59E3, Rocket, Practice, 2.36 inch, T60E3 and Fuze, Rocket, PD, T2000E1 be continued with a priority of 1-C.

REUBEN E. JENKINS
Brigadier General, USA
President

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R/T

471.94 (C)(27 Sep 45)
GNRQT-11/42979 2d Ind.

HEADQUARTERS ARMY GROUND FORCES, Washington 25, D. C., 9 October 1945

TO: Commanding General, Army Service Forces. ATTENTION: Research and Development Division, Room 4E 633, The Pentagon

1. The attached report of the Infantry Board (now Army Ground Forces Board No. 3), covering the Rocket, High Speed, T59, is forwarded for your information. The recommendations contained therein relative to modifications required in the T59 Rocket were transmitted to your office as the need of each modification became apparent.

2. At conferences between representatives of this office and the developing agency, it was brought out by the latter that the T59 Rocket is laboratory manufactured and is incapable of mass production owing to the nature of construction of the rocket. Further, that attempts to improve the fuze and motor have led to a modification which requires a small metal part to be blown rearward when the rocket is fired, and that the velocity of the part is high, its trajectory unpredictable, with resultant large danger space in rear of the launcher. Such a reaction, on the surface, is cause for rejection of the modification. It may be that a completely new design, possessing the performance of the T59 Rocket, is necessary.

5"

3. The present standard bazooka rocket was designed primarily as an anti-tank weapon. However, with its accuracy limited to ranges of less than 100 yards and with its limited armor penetration, the weapon was only moderately successful. Later in the war, it did find application against caves and pill boxes, but only in limited degree. Successful development of a rocket of the T59 type, possessing great accuracy up to 600 yards and usable accuracy up to 1000 yards, with armor penetration of over 7 inches, would change the 2.36" launcher and rocket (bazooka) from a primarily defensive weapon to a primarily offensive weapon. It would place in the Infantry type rifle company a very mobile, direct fire weapon weighing only 10 lbs, with accuracy and performance sufficient to neutralize up to ranges of 1000 yards emplaced machine guns, overhead cover foxholes and trenches, pill boxes, cave entrances, and similar defensive installations.

4. The 3.5" Rocket and Launcher are nearing standardization. That rocket, if development is successful, will possess usable accuracy up to 600 yards, with over 11 inches of armor penetration. It will not replace the 2.36" launcher and rocket, but probably will become the primary bazooka for anti-tank fire. One would supplement the other. In order to arrive at a firm tactical employment and resultant basis of issue, it is necessary to push to successful conclusion the development of both calibers of rocket.

5. It is requested that further development be expedited under

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IB-471.9

Office of
THE INFANTRY BOARD

Fort Benning, Georgia

19 SEP 1945

SUBJECT: Rocket, High Velocity, 2.36", T-59

THROUGH: The Commandant, The Infantry School,
Fort Benning, Georgia.

TO: The Commanding General, Army Ground Forces,
Army War College, Washington 25, D. C.

1. Authority. No formal written directive for test of the subject Rocket, High Velocity, 2.36", has been received. After the material was on hand, information was received on 6 June 1945 from Hq. Army Ground Forces, Requirements Section (Lt. Col. Feldman), by telephone, on 6 June 1945, to the following effect:

> "Original lot of 2.36" T59 rockets ("Super bazooka") received by The Infantry Board 19 May are unsatisfactory in so far as penetration is concerned. They may be used for tests not involving penetration. A new lot is being shipped to The Infantry Board. When new lot is received please inform Army Ground Forces Headquarters (Requirements) when test will be continued as visitors from Allegheny Ballistics Laboratories desire to be present."

On 19 June 1945 further telephonic instructions from the same source were received as follows:

> "Proceed with the T-59 Rockets rather than wait for the new ammunition."

2. Description of Material. The subject rocket ~~is~~ designed for launching from the present, standard Rocket, 2.36", M6A3 represents a complete re-design which has nothing in common with the standard item except the caliber and means of launching, in an effort to obtain greater effectiveness, especially in range, accuracy and power. It differs from the M6A3 model principally as follows:

Longer.
Heavier.
Higher velocity.
More powerful high-explosive charge.
Point-detonating fuze. (Modified M52)

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Hinged, radially folding stabilizer fins.
Shape of entire rocket cylindrical and of uniform diameter except for the tapering nose, and the constriction over the venturi which forms a recess into which the fins are folded prior to firing.

(Record of Test, pp 10 & 11; Figs. 1, 2 & 3)

3. Purpose. a. To determine the performance and functional characteristics of the subject Rocket, High Velocity, 2.36", T59 as compared with the present standard Rocket, 2.36", M6A3, and its general effectiveness and suitability as ammunition for the 2.36" Rocket Launcher.

b. This report is submitted at this time as purely intermediate in view of the uncertainty as to when, if at all, material embodying the latest modifications will be available, and in order to make of record partial data obtained to date.

4. Factual Background. a. The 2.36" rocket has, since it was initially adopted in 1942, gained universal recognition as a lightweight weapon suitable for use by foot troops against armored vehicles and comparable stationary emplacements, as well as against personnel. It has, however, been found to have some shortcomings, the most serious of which are lack of sensitivity in the impact fuze and instability in flight, resulting in a high percentage of duds, especially on grazing impact, and low accuracy. The relatively low velocity also produced a curved trajectory which made it difficult to obtain hits beyond point blank ranges. Successive models, incorporating different stabilizer fins, a blunt nose and a more sensitive fuze, have failed to render the rocket entirely satisfactory. The advent of very heavy armor, as encountered in the European Theater of Operations has also created the need for more armor penetration in this rocket. The subject Rocket, High Velocity, 2.36", T59 represents an attempt to remedy all defects and shortcomings in the 2.36" rocket, including greater range, greater accuracy, greater power and more reliable functioning.

b. Closely related to development of the subject rocket is that of the new 3.5" rocket for which a successful launcher has been developed which is in the same general class as to portability and ease of operation with the present standard 2.36" rocket material, while the ammunition for it has been developed to the point where its standardization has been recommended with certain minor modifications and seems assured. The powers and characteristics of that material are such that its field of usefulness overlaps that of any 2.36" rocket that may be devised, including the subject model, and the two must therefore be considered together. (See Report of The Infantry Board No. 1826, 16 July 1945, Subject: Partial Report on Launcher, Rocket, 3.5", T74 and Rocket, 3.5", T80.)

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c. Also related to this project is the program for development and production of recoilless weapons, some of which appear to be distinctly complementary to the one-man, front-line ("Bazooka") type of rocket launchers and their ammunition. Of the recoilless weapons now existing or under development, those most closely related to the subject type of material are:

The 57mm Recoilless Rifle. (In production)
The 60mm Recoilless Mortar.(Under development)
The 37mm Recoilless Rifle. (Under development).

These recoilless weapons differ essentially from the rocket types chiefly in that, in general they:

Are heavier and less portable.
Have much greater range and accuracy.
Have less destructive and penetrative power in proportion to weight of weapon and ammunition.

The general result of improvement of the light rockets such as the subject item in range and accuracy is to bring them closer to the recoilless weapons in tactical application and render more difficult the choice between them.

5. Essential Facts disclosed by the instant tests, (details of which are given in the annexed Record of Test) are:

a. The subject Rocket, High Velocity, 2.36", T59 is twice as heavy as the standard item and, with fins folded, occupies approximately one-sixth more cubic space. (Test No. 1)

b. For firing at moving targets, the subject rocket requires only approximately one-half the angular lead necessary for the standard 2.36" Rocket, M6A3, or approximately 2.5 mils for each mile per hour in the lateral speed of the target at effective ranges. (Test No. 2)

c. The accuracy of the subject rocket is substantially greater at ranges up to 300 yards than that of the standard 2.36" Rocket, M6A3, and is many times as great at ranges over 300 yards. (Test No. 3)

d. The inherent accuracy of the subject Rocket is sufficient to assure hits on targets of the size of a small vehicle or a machine-gun emplacement at a range of 500 yards or more, assuming correct range-data and correct aiming of the launcher, and renders the probability of a hit under such conditions many times greater than with the standard 2.36" rocket. (Test No. 3)

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e. The extreme range of the subject T59 Rocket, at normal temperature (90°F.) and at an elevation of 580 mils, is approximately 1350 yards, or approximately twice that obtainable with the standard M6A3 Rocket. (Test 4)

f. The inherent accuracy for high-angle (mortar type) fire of the subject T59 Rocket is sufficient to insure effective hits on small area targets at ranges up to approximately 1300 yards. (Test 4)

g. The subject Rocket, T59 is adequately stable in flight to insure head-on impact and normal trajectory under conditions normally to be expected. (Test 5)

h. Ignition of the propellant in the subject Rocket, 2.36", T59, is subject to failure in a ratio as high as approximately one in ten, and has a delay or "hang-fire" of from one-tenth to three tenths of a second between the firing of the ignition squib to the departure of the rocket, causing an adverse psychological effect upon the firer and consequent dernagement of aim. (Test 6)

i. The launching of the subject Rocket, T59, with the standard launchers produces no appreciable back-blast or muzzle flash from the propellant after emergence from the launcher at temperatures between 8 degrees, Fahrenheit and 120 degrees Fahrenheit. (Tests 7 and 9)

j. Launching of the subject Rocket, T59, from the present standard Launcher, M9A1 and M9E2, produces no appreciable recoil of the launcher. (Test 8)

k. The subject Rocket, T59, as received for test, is subject to fuze malfunction and wholly unreliable on grazing impact on level ground resulting from direct fire at all ranges up to over 300 yards, apparently attributable to the striker failing to make sufficient contact with the ground due to its position with respect to the slope of the ogive. (Test 10)

l. Either of the following modifications of the subject rocket, T59, appears to reduce the ratio of fuze malfunctions on grazing impact to a satisfactory figure without appreciably affecting its ballistic performance:

(1) Place a disc on and over the forward end of the striker, extending its contact area laterally sufficiently to insure engagement with the ground before the base of the ogive deflects the rocket. (Figure 12, a.)

(2) Place a 3/4" forward extension on the end of the striker, for the same purpose as in a, above. (Figure 12, c) (Test 10)

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m. The use of the subject Rocket, T59 in Launcher, 2.36", M9A1 produces no adverse effect on the latter except severe erosion of the rocket latch. (Test 11)

n. Use of the subject Rocket, T59, in the standard Launcher, Rocket, 2.36", M9E2 causes rapid erosion and early failure of the breech collar and latch. (Test 11)

o. The propellant chamber of the subject Rocket, T59, is not waterproof, and permits entry of water to the igniter and propellant under submersion in water. (Test 12)

p. The proportion of fuze malfunctions in the subject rocket, other than on grazing impact, is less than two percent (2%). Low-order detonations may be expected in a ratio of approximately three percent. (3%) (Test 13)

6. Discussion.

a. It is evident from the partial tests reported herein that Rocket, High Velocity, 2.36", T59, represents a great and essential forward step in the development of the 2.36" rocket, and advances it into a class which may be regarded as a precision weapon at ranges up to several hundred yards. By this is meant that its accuracy begins to be commensurate with the ability of the average user to aim and fire under normal combat conditions. It is hardly to be expected that greater accuracy will be obtained or can be utilized in a shoulder weapon. Further, aside from its use for flat trajectory fire against armored vehicles and other point targets requiring high explosive treatment, its high angle ranges and its accuracy at those ranges when used as a mortar makes it a strong competitor of the 60mm mortar for missions now considered normal for the latter. While no test of its armor penetrating power was made in view of lack of appropriate armor-plate and of the notification that the model as received was not considered ready for final evaluation, the power predicted for it and the increased weight and improved character of the explosive charge would indicate its capability of dealing with all except the very heaviest of armor found only on the front of the heaviest tanks now in existence. This greater power, combined with an accuracy that will enable accurate placement of the hit upon selected portions of the target, indicate a tremendous increase in effectiveness over present material, even with the subject rocket in its present form.

b. Only two weaknesses are revealed by The Infantry Board tests. They are:

(1) Failure of the fuze to function on grazing impact.

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(2) Damage to the launcher, M9E2.

The first of these could be readily predicted by consideration of the geometry of the nose and fuze body, which precludes contact of the striker when the angle of incidence is less than the angle of taper of the ogive. A simple modification made, experimentally, by The Infantry Board, which altered this geometry by extending the striker, appeared to remedy this weakness and produce satisfactory performance. The second is more properly a weakness in the design of the launcher, M9E2, which places various protuberances from the breech of the launcher to extend into the path of the propellant blast. It goes without saying that such protuberances will be subject to tremendous pressure and erosion, and must be eliminated or so designed as to be quickly replaceable in the field before the launcher can be considered capable of handling any high-velocity rocket. A different device for holding the rocket in the launcher and making the necessary electrical contacts seems essential to the success of this rocket or any rocket of similar power.

c. Assuming the successful elimination of the defects discussed above, the exact role to be played by the high velocity rocket, in view of the existence of the 3.5" Rocket and the 57mm Recoilless Rifle, presents a question of some difficulty, which is discussed in Report of The Infantry Board No. 1826, covering the 3.5" Rocket T80 and its launcher. It need only be repeated, here, that the subject, high velocity, 2.36" Rocket and the 3.5" Rocket appear to be mutually complementary in the tactical sense. The latter is more powerful but has only about half the effective range of the subject rocket. The ability to obtain effective hits at greater range gives an advantage which cannot be disregarded, and which will undoubtedly save many casualties. On the other hand, the power which makes a hit on an enemy tank practically tantamount to a kill, even at a sacrifice in range, is also a vital necessity. In spite, therefore, of the undesirability of increasing the number of types of ammunition used by front line troops, a combination of the two seems inescapable for front line troops. Cessation of development of either would be a grave mistake.

d. As to the 57mm Recoilless Rifle, close analysis will reveal no conflict in functions. There is an obvious overlap between the light rocket and the recoilless weapons, but each has important characteristics not possessed by the other. The rocket cannot yet compete with the recoilless rifle in range and accuracy, but neither can the present recoilless weapons compete with the rocket in portability, power within range limitations and facility of operation. The Infantry Board believes that there is need, within the rifle company, of the recoilless rifle as well as of both the 2.36" high velocity, long-range rocket and the 3.5", high power, short range rocket.

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7. Conclusions. The Infantry Board concludes:

a. That there is an urgent military requirement for a high-velocity, long-range, 2.36" Rocket for use by foot-troops.

b. That the subject Rocket, High Velocity, 2.36", T-59, is defective only in that it is unreliable and ineffective on grazing impact.

c. That, when modified so as to insure functioning of the fuze on grazing impact, (and assuring satisfactory armor penetration) the subject Rocket, High Velocity, 2.36", T-59 will be highly satisfactory and desirable for adoption as replacement for one-half the present, standard 2.36" Rocket, M6A3, in Infantry rifle companies and other units with similar combat missions, as complementary to a similar number of 3.5" Rockets and its launchers.

d. That re-design of the breach of the Launcher, Rocket, 2.36", M9E2 to avoid destructive erosion and pressure is necessary for the successful use of the subject rocket or any other high velocity rocket.

e. That there is an overlap in tactical functions between the high velocity, 2.36" Rocket, the 3.5" Rocket and the 57mm Recoilless Rifle, but no such conflict as would justify elimination of any one of them.

f. That the closure of the propellant chamber of the subject rocket is inadequately waterproof.

8. Recommendations. The Infantry Board recommends:

a. That the subject Rocket, High Velocity, 2.36", T-59, be modified so as to improve functioning of the fuze on grazing impact either:

(1) By changing the contour and dimensions of the striker so as to insure adequate contact with the ground on grazing impact, or

(2) By providing a base detonating fuze which will function on change of direction caused by ricochet of the grenade as well as upon linear deceleration.

b. That the closure of the propellant chamber of the subject rocket be made adequately waterproof.

c. That when so modified, (and assuming satisfactory armor-piercing performance) the subject Rocket, High Velocity, 2.36", T59, be adopted as standard and issued in lieu of one-half of the present allowance

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of 2.36" rockets in Rifle Companies and other units with similar tactical missions, as complementary to a similar basis of issue for the 3.5" Rocket, T-80.

d. That, upon adoption and issue of the subject rocket, further production and issue of the present standard Rocket, 2.36", M6A3 be discontinued.

e. That the present standard Launcher, Rocket, 2.36", M9E2, be modified for use with the subject Rocket, High Velocity, 2.36", T-59, as follows:

(1) Elimination of projections or protuberances on the breech, extending into the path of the propellant blast.

(2) Calibration of the sight to match the ballistics of the subject rocket.

DAGOMAR M. OSETH,
Colonel, Infantry,
President.

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RECORD of TEST

ON

ROCKET, HIGH VELOCITY, 2.36", T59

TEST SECTION
THE INFANTRY BOARD
FORT BENNING, GEORGIA

TO: THE DIRECTOR, THE INFANTRY BOARD.
HEREWITH DETAILED RECORD OF TESTS RELATING TO THE ABOVE PROJECT.

WILLIAM C. RUTHERFORD,
Lt. Colonel, Infantry,
CHIEF, TEST SECTION

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8 Copies.

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TEST SECTION
THE INFANTRY BOARD
FORT BENNING, GEORGIA

SUBJECT: RECORD OF TEST OF ROCKET, HIGH VELOCITY, 2.36", T59.

TO: THE PRESIDENT, THE INFANTRY BOARD, FORT BENNING, GEORGIA

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By NAKA Date 9 DEC 22

1. Authority and References.

a. Authority:

(1) Memorandum, The Infantry Board, IB-471.9, 1 June 1945. (Appendix "A")

b. References:

Field Manual 23-30.

2. Introductory Information.

a. The subject T59 rocket was developed in an effort to secure a greater efficiency from the 2.36" rocket launcher by means of increasing the muzzle velocity so as to reduce necessary leads on moving targets and secure greater range and accuracy through the flatness of trajectory.

b. The subject rocket departs from the design of the 2.36" Rocket M6A3 in many ways. The T59 Rocket has a point detonating fuze that is a modification of the M52 Mortar Fuze. This fuze is standard in components except for the shaped charge for relaying the fuze action to the booster in the base of the explosive head. The fuze had the standard bore rider and is operated by the change of velocity due to firing (Figures 1, 3, 4).

The explosive head of the T59 Rocket has a hollow stand-off ogive and copper cone for forming the armor piercing shaped charge. (Figures 1, 3) From the point of the cone to the base of the explosive head is a tube for passage of the relay jet from the fuze to the tetryl booster at the base of the shaped charge (Figure 4).

The explosive head is fastened to the propellant chamber by means of a metal journal. (Figure 3)

The propellant chamber is the same in outside diameter as the explosive head. The rear of the propellant chamber is formed into a venturi tube for expansion of the propellant gases. The venturi is closed by a plastic cup which is cemented into place. Two ignition wires to the electric firing squib pass through the center of the plastic cup. One of the wires is soldered to the venturi tube while the other is a long wire for attachment to the terminal of the launcher. (Figures 3, 5, 6)

The propellant for the T59 Rocket is BBP. The powder is cut in flat rings of three sizes and is mounted on a rack that is centered axially

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in the propellant chamber. The large rings are mounted over a black powder ignition unit which is started by the electric squib. (Figure 5)

The venturi of the T59 Rocket has a tail fin ring mounting on it which supports six small vane fins. The fins are held folded forward by a metal collar before firing and are released to spring into position nearly at right angle with the long axis of the grenade upon clearing the muzzle of the launcher. The rocket may be fired with the collar over the fins or the collar may be removed after the rocket is latched in the firing position. The tail fins are notched to receive the tail latch of the launcher. (Figures 1, 2, 6)

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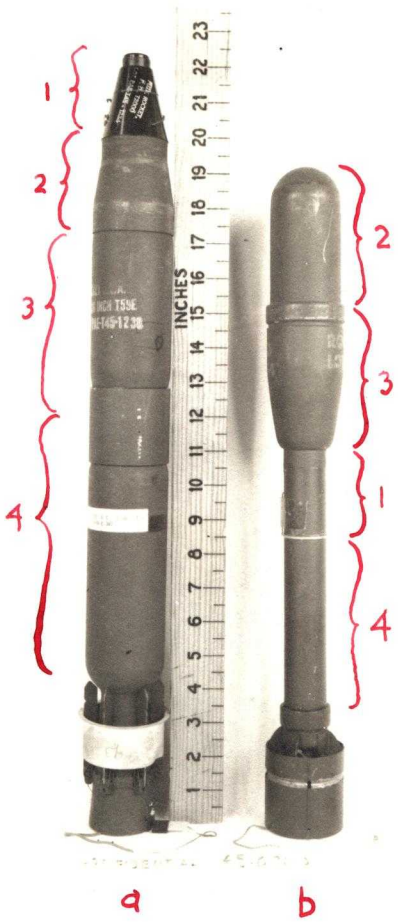

Rockets for 2.36" Launcher.

a - T59 Rocket - note collar to hold tail fins in folded position.

b - M6A3 Rocket - standard.

1 - Fuze.
2 - Ogive.
3 - Explosive charge.
4 - Propellant chamber.

Figure 1

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T59 Rocket with tail fins in place for flight.

Figure 2

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a b c d e f g

Components of T59 Rocket.

a - Fuze T2000 - Modified Fuze M52.

b - Explosive charge. Ogive and shaped charge.

c - Tetryl booster.

d - Cardboard gaskets.

e - Journal connecting explosive head and propellant chamber.

f - Propellant - BBP discs on shaft with ignition unit complete.

g - Propellant chamber and fins.

Figure 3

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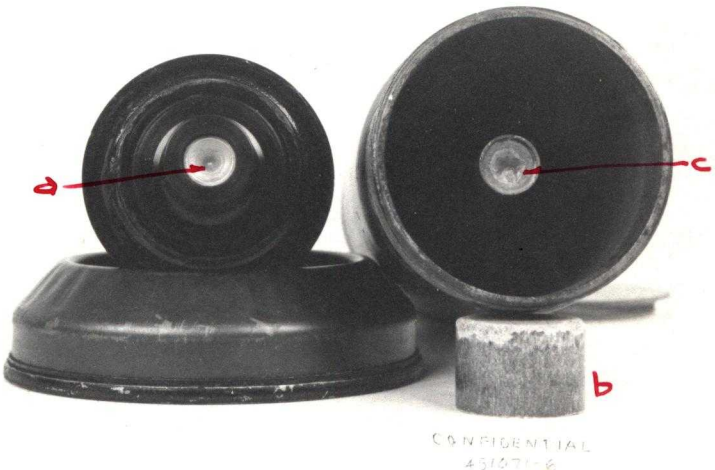

Functioning of Fuze of T59 Rocket.

a - Shaped charge in Fuze T2000 which flashes down tube through center of charge.

b - Tetryl booster at base of flash tube which is detonated by shaped charge in fuze.

c - Base of tube through which shaped charge in fuze detonates tetryl booster.

Figure 4

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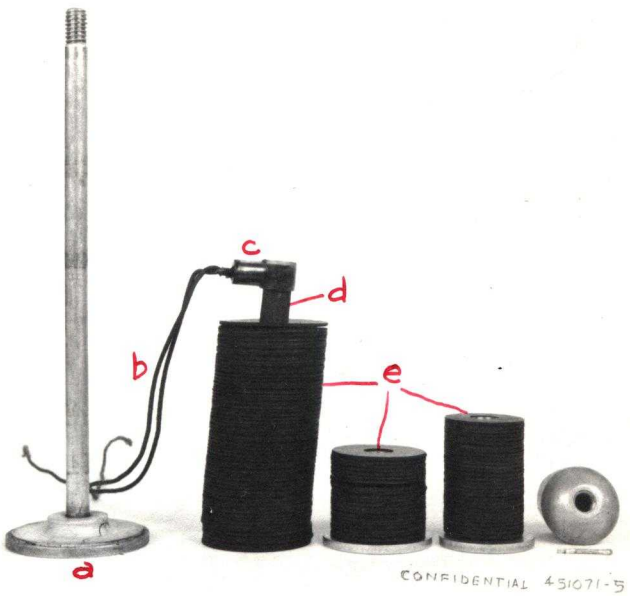

Components of Propellant Unit

a - Power rack

b - Ignition wires

c - Electric squib

d - Black powder ignition sleeve

e - BBP powder discs

Figure 5

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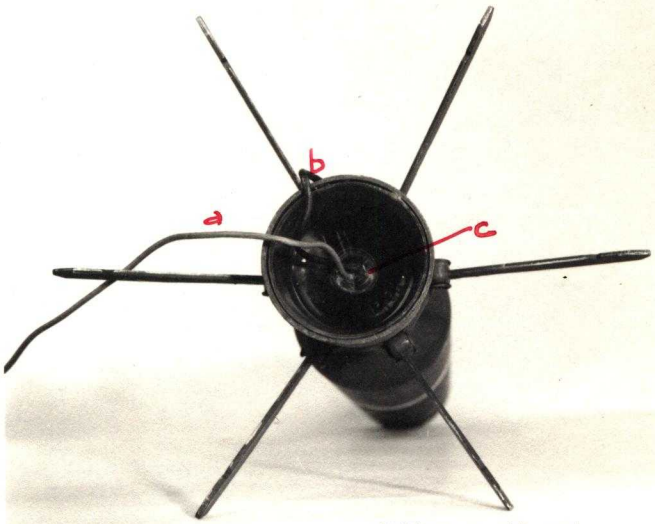

Rear View of T59 Rocket.

a - Ignition wire for attaching to launcher terminal.

b - Ignition wire grounded to rocket shell.

c - Plastic cup within venturi. Note ignition wires pass through center of cup.

Note spread of fins.

Figure 6

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3. Purpose of Test.

a. To compare the subject T59 and M6A3 Rockets as follows where applicable:

(1) Physical characteristics.

(2) Lead necessary when firing at moving targets.

(3) Accuracy at 100, 300, and 500 yards on a vertical and ground target.

(4) Dispersion when fired at maximum range using rockets subject to normal and extreme temperatures.

(5) Stability in flight.

(6) Ratio of range and elevation.

(7) Functioning of propellant during tests.

(8) Effect of extreme temperatures on back blast and stability.

(9) Recoil when fired in the M9A1 and M9E2 Launchers.

(10) Effect of submerging T59 Rocket in water for four hours.

(11) Functioning of fuze of T59 Rocket on grazing impact with ground.

(12) Effect of modifying striker of fuze on ratio of duds at low angles of incidence and on stability of rocket.

(13) Effect of T59 Rocket on M9A1 and M9E2 Launchers.

(14) Other pertinent data.

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4. Details of Tests and Results.

Test No. 1.

a. Purpose: To compare the physical characteristics of the Rockets T59 and M6A3.

b. Method: By inspecting, weighing and measuring.

c. Results:

(1) See Figures 1 thru 6.

(2) Weights and measurements:

Rockets	M6A3	T59
Diameter (in.)	2.36	2.36
Length (in.)	19.37	22.25
Weight (lbs.)	3.42	6.82
Type fuze	Base Detonating	Point Detonating
Type cone	Steel	Copper
Weight of explosive (lbs.)	.64	.93
Propellant	Standard	BBP
Tail fins	Tunnel	Vane
Safety features	Safety pin	Safety pin and set back arming with bore rider.

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Test No. 2

a. Purpose: To determine the necessary lead when firing at moving targets when using the T59 and M6A3 Rockets.

b. Method:

(1) By firing at a moving target at 500 yards and determining the amount of lead necessary to engage a target moving at 10 mph. at 90 deg. to the direction of fire.

(2) Four rounds of each type of ammunition were fired at the moving target moving from right to left and the same from left to right.

(3) The time of flight of the rockets was recorded and the average velocity calculated.

c. Results:

(1) Results of firing.

Rocket	T59		M6A3	
Lateral Speed of Target (mph)	7.07		7.07	
Direction of Target	Left to Right	Right to Left	Left to Right	Right to Left
Rounds Fired	4	4	4	4
No. of Hits	2	1	0	0
No. with Correct Lead	3	3	1	2
Mils lead	18	18	37	37
Average lead (Mils per mile per hour)	2.5	2.5	5.2	5.2

(2) Note the following.

Rocket	M6A3	T59
Time of Flight (sec) (average of 8 rounds)	7.1	3.7
Average Velocity (ft/sec) at 500 yards	212	405

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Test No. 3

a. Purpose: To determine the accuracy of the M6A3 and T59 Rockets at ranges of 100, 300 and 500 yards.

b. Method:

(1) Three rockets of each type were fired at a 6' x 6' panel placed at 100, 300 and 500 yards.

(2) The vertical, lateral and ground dispersion was measured for each type of rocket at each range.

(3) The angle of elevation of the launcher was recorded for each range and type of rocket.

c. Results:

(1) Results of firing. (See Figures 7 and 8)

Rocket	M6A3			T59		
Range to Panel (yds.)	100	300	500	100	300	500
Elevation (mils)	62	213	411	32	84	149
Lateral Dispersion (ft.)	.5	1.0	20.4	.35	.95	1.75
Vertical Dispersion (ft.)	1.0	6.1	30*	.25	1.0	2.9
Range Dispersion on Ground (yds.)	2.0	9.5	26.5	1.0	2.5	5.0
Average Range of Strike on Ground (yds.)	108	310	533	103.5	321.2	502.3

*Estimated from observation of firing.

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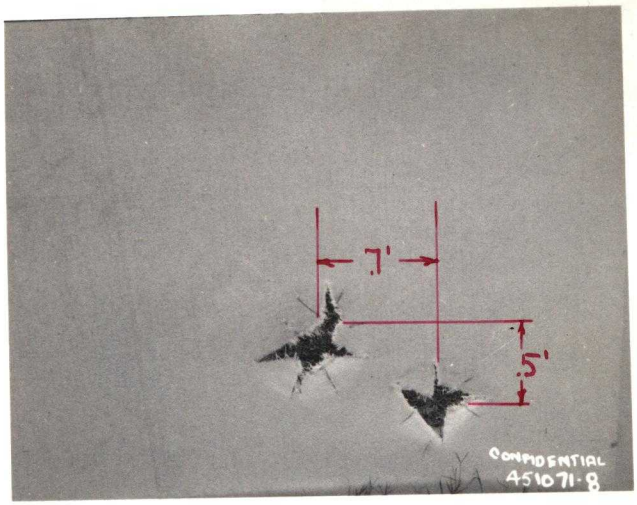

Shot Group, 100 yards.

Figure 7

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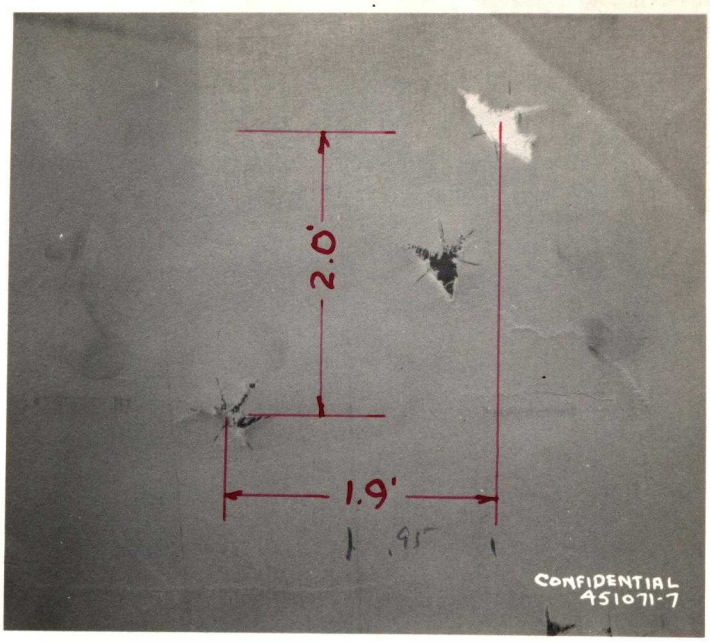

Shot Group, 300 yards

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Figure 8

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Test No. 4

a. Purpose: To determine the maximum range and dispersion of the T59 Rocket when fired at normal and extreme temperatures using the maximum sight setting on the rocket launcher.

b. Method:

(1) Four rounds were fired at an elevation of 580 mils at a normal temperature of 90 degrees F.

(2) Three rounds were fired at an elevation of 580 mils after being subjected to a temperature of 120 degrees F. for 24 hours.

(3) Three rounds were fired at an elevation of 580 mils after being subjected to a temperature of 8 degrees F. for 24 hours.

(4) The range to each round and the lateral dispersion was measured and recorded.

c. Results:

(1) Normal Temperatures:

Round No.	Range (Yds.)
1	1354
2	1294
3	1340
4	1364
Average	1338 yards

The lateral dispersion of the four rounds was 2 yards.

(2) Extreme temperatures: (120 deg. F.)

Round No.	Range (Yds.)
1	1083
2	1250
3	1263
Average	1199 yards

Lateral dispersion: 3-1/3 yards.

(3) 8 Degrees F.

Round No.	Range (Yds)
1	1279
2	1105
3	1183
Average	1189 yards

Lateral dispersion: 2-1/3 yards.

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Test No. 5

a. Purpose: To determine the stability of the T59 Rocket when fired during tests of normal temperatures in the open and when fired through brush. To determine the effect of extreme temperature on the stability of the T59 Rocket.

b. Method:

(1) By observation of the flight of the T59 Rocket during tests.

(2) By observation of the flight of a T59 Rocket after passing through leafy foliage.

c. Results:

(1) All T59 Rockets subject to either normal or extreme temperatures were stable in flight. Tendency to yaw was negligible.

(2) Light or leafy foliage has no effect on the stability of the T59 Rocket.

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Test No. 6

a. Purpose: To determine the number of propellant failures and propellant defects during tests conducted.

b. Method: By observation of firing and inspection of defective rounds.

c. Results:

(1) Out of 69 rounds fired there were 6 ignition failures. Four failures were due to broken wires within the propellant chamber. Two failures were due to ignition wires being twisted together and short circuited within the propellant chamber.

(2) In every case of firing the subject rockets had a delay of from .1 to .3 seconds between the firing of the propellant squib and the ignition of the propellant. This caused a great deal of uncertainty in the firer especially when firing at moving targets.

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Test No. 7

a. Purpose: To determine the effect of extreme temperatures on the back blast of the T59 Rocket.

b. Method:

(1) By observation of the firing of rockets subject to temperatures of 8 degrees F. and 120 degrees F.

(2) Inspection of the blast deflector on the muzzle of the launcher after firing each type of ammunition.

c. Results:

(1) There was no evidence of burning of the propellant after the T59 Rockets subject to extreme temperatures left the launcher.

(2) Inspection of the blast deflector of the M9E2 Launcher failed to disclose any blast or splintering due to the rockets being subject to extreme temperatures.

(3) There was a decided reduction in the report of the propellant at both extreme temperatures.

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Test No. 8

a. Purpose: To compare the recoil of the T59 and M6A3 Rockets when fired in the M9A1 and M9E2 Launchers.

b. Method:

(1) Two rounds of each type of rocket were fired in a pendulum device using each type of launcher.

(2) The rockets were fired by remote control and the recoil of the launcher and resultant lift noted and converted into foot pounds of energy.

c. Results:

Rocket	M6A3		T59 *	
Launcher	M9A1	M9E2	M9A1	M9E2
Weight (lbs.)	14.97	10.15	14.97	10.15
Energy (ft./lbs. developed)	6.83	7.12	None	None

*In no instance during the firing of the T59 Rocket was there any tendency of the launcher to recoil.

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Test No. 9

a. Purpose: To determine the amount of back blast of the T59 Rocket and the distance the propellant burns in the launcher tube.

b. Method:

(1) Photographs were taken of the back blast of the T59 Rocket when fired from the full launcher and the breech section of the launcher. (Figures 9, 10 and 11)

(2) Observation of the firing and inspection of the photographs were made to determine if there was any muzzle flash or burning of the rocket in the muzzle section of the launcher tube.

(3) The photograph was calibrated and the flame measured.

c. Results:

(1) There is no muzzle flash when firing the T59 Rocket. (Figure 10)

(2) The propellant of the T59 Rocket burns in the breech section of the tube only. (Figure 11)

(3) The flame from the propellant of the T59 Rocket extends 9.25 feet to the rear of the launcher. (Figure 10)

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Back Blast of T59 Rocket during daylight

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Figure 9

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Flash of T59 Rocket fired from complete tube of M9E2 Launcher.

Length of flame: 9.25 feet

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Figure 10

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Burning time of Propellant in T59 Rocket. Rocket fired from breech section of M9E2 Launcher. Note that there is no muzzle flash.

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Figure 11

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Test No. 10

a. Purpose:

(1) To determine the comparative functioning of the fuzes of the M6A3 and T59 Rockets when fired at low angles of incidence.

(2) To determine the effect of modifying the striker on the T59 Rocket on:

(a) Ratio of duds when firing grazing fire.

(b) Ballistics of the T59 Rocket.

b. Method:

(1) Observation of firing at 100 and 300 yards using the M6A3 and T59 Rockets as received.

(2) Twelve rockets T59 were modified. Six had a button placed over the striker to extend the contact surface laterally, and six were modified to extend the striker 3/4 inch forward to decrease the contact angle. (Figure 12)

(3) The modified rockets were fired at 100 and 300 yards where the unmodified rockets had been fired, and the results noted.

c. Results:

(1) Record of firing with low angles of incidence.

Rocket	M6A3	T59 As received	T59 Button	T59 Extension
Range 100 yds:				
Rounds Fired	5	5	3	3
Duds	5	5	0	1*
Percent Duds	100	100	0	33
Range 300 yds:				
Rounds Fired	6	5	3	3
Duds	4	4	0	0
Percent Duds	67	80	0	0

*Ricochet - burst 20 yards beyond initial point of impact.

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(2) The subject rocket is equipped with a plastic fuze that is easily broken, especially the fuze striker. In every case the duds had the striker broken off indicating the possibility of a failure due to structural weakness.

(3) The modification of the subject rockets appeared not to effect the ballistics of the T59 Rocket.

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a b c

Modification of fuze of T59 Rocket to improve functioning on grazing impact.

a - Button attachment to extend contact surface of striker.

b - Standard fuze

c - Extension of striker to secure contact with ground.

Figure 12

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Test No. 11

a. Purpose: To determine the effect of the T59 Rocket on the M9A1 and M9E2 Launchers.

b. Method:

(1) Ten rounds of T59 Rockets were fired in the M9A1 Launcher and the results noted.

(2) Three M9E2 standard Launchers had 8, 5 and 1 rounds respectively fired in them and the results noted.

(3) One modified M9E2 Launcher (latch modified) (Fig. 13) fired 43 rounds of T59 Rockets and the results were noted.

c. Results:

(1) Ten rounds of T59 Rocket did not affect the tube of the M9A1 Launcher. Serious preliminary erosion was evident on the rocket latch of the launcher at the completion of the firing.

(2) The breech protection collar was blown partially off of three M9E2 Launchers after firing 1, 5 and 8 rounds respectively. This damage appeared to be due to the high velocity gas deflection by the rocket latch impinging on the collar and stripping the screws from the launcher tube. (See Figure 13)

(3) Forty-three rounds were fired in one M9E2 Launcher on which the rocket latch had been modified (Figure 13). Failure of the breech protection appeared to be due to accumulative erosion of the screw holes in the launcher tube resulting in the release of the screws. The contact surface of the latch had lost approximately 1/8" of its length due to the erosion of the propellant gas.

(4) There were no effects within the launcher tube due to firing the T59 Rockets.

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Damage to M9E2 Launcher due to firing T59 Rockets.

Three launchers were damaged in this manner due to the velocity and errosion of propellant gases blowing screws from the protective collar on the breech of the launcher.

Modification of the latch as shown prolonged the life of the launcher; however, the latch was severely erroded by the propellant gases after firing 43 rounds.

Figure 13

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Test No. 12

a. Purpose: To determine the effect of submerging the T59 Rocket in water for four hours.

b. Method: Three T59 Rockets were placed in 12" of water for four hours and then inspected.

c. Results:

(1) All three rockets were found to have a large quantity of water in the propellant chamber.

(2) The plastic cup on the propellant chamber was out of one of the rockets after the four-hour period.

(3) No attempt was made to fire the rockets as the black powder igniter unit had disintegrated in the water.

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Test No. 13

a. Purpose: To determine failures of the T59 Rocket during normal firing.

b. Method: By observation of test firing.

c. Results:

(1) One T59 Rocket failed to detonate on impact after a flight of 1400 yards. The fuze had armed.

(2) Two low order detonations were noted during the test firing. (Figures 15 and 16)

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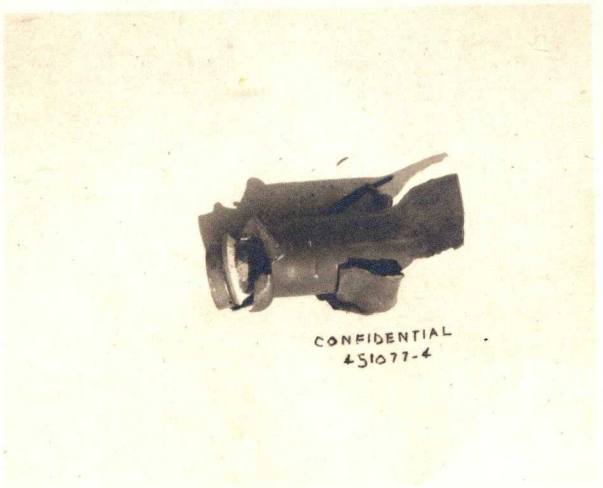

Low Order Detonations of T59 Rocket
Two rounds were found that had failed due to the tetryl booster failing to detonate the charge.

Figure 14

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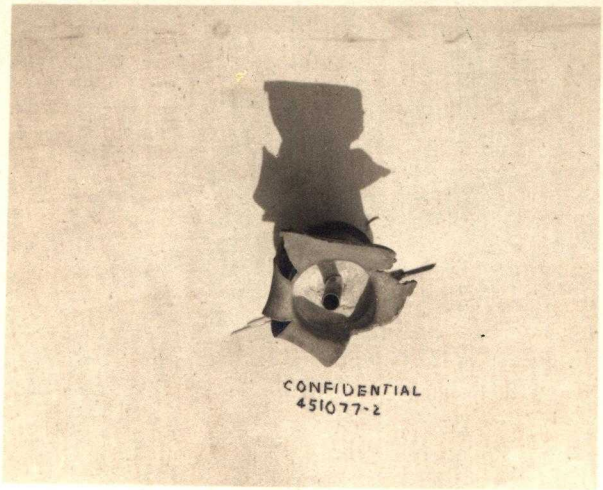

Low Order Detonation of T59 Rocket
Base of explosive head showing flash tube and effect of booster detonating but failing to detonate filler.

Figure 15

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5. Summary of Facts Determined by Tests.

a. The following are characteristics of the M6A3 and T59 Rockets: (Test No. 1)

Rockets	M6A3	T59
Diameter (in.)	2.36	2.36
Length (in.)	19.37	22.25
Weight (lbs.)	3.42	6.82
Type fuze	Base Detonating	Point Detonating
Type cone	Steel	Copper
Weight of explosive (lbs.)	.64	.93
Propellant	Standard	BBP
Tail fins	Tunnel	Vane
Safety features	Safety pin	Safety pin and set back arming with bore rider

b. The T59 Rocket has an average velocity of 405 feet per second at 500 yards and requires a lead on moving targets of 2.5 mils per mile per hour. (Test No. 2)

c. The T59 Rocket is more accurate than the M6A3 Rocket at 100, 300 and 500 yards. The elevation of the launcher when firing the T59 and M6A3 Rockets is as follows: (Test No. 3)

	Elevation (Mils) M6A3	T59
Range 100 yds	62	32
300 yds	213	84
500 yds	411	149

d. The range of the T59 Rocket at a sight setting of 600 yards on the M9E2 Launcher (580 mils) is approximately 1338 yards at normal temperatures. (Test No. 4)

Extreme temperatures both hot and cold increase the range dispersion and decrease the average range of this rocket when fired at the same elevation as those at normal temperatures. (Test No. 4)

e. All T59 Rockets fired appeared to be stable in flight. One T59 Rocket fired through leafy vegetation was stable in flight. (Test No. 5)

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f. Six ignition failures were noted during the firing of 69 rounds of T59 ammunition. All T59 Rockets fired had a delay of .1 to .3 seconds between the firing of the squib and the ignition of the propellant. (Test No. 6)

g. Extreme temperatures appear to reduce the amount of report of the propellant. (Test No. 7)

There was no evidence of burning propellant at the muzzle of the launcher or of splintering due to extreme temperatures. (Test No. 7)

h. The M9A1 and M9E2 Launchers have no noticeable recoil when firing the T59 Rocket. (Test No. 8)

i. The T59 Rocket has no muzzle flash when fired in the rocket launcher. (Test No. 9)

The T59 Rocket propellant burns completely in the breech section of the rocket launcher. (Test No. 9)

The flame of the T59 Rocket extends 9.25 feet to the rear of the rocket launcher. (Test No. 9)

j. The number of duds had during firing at low angles of incidence onto hard ground can be greatly reduced by the addition of an extension (axially or laterally) on the fuze striker of the T59 Rocket. (Test No. 10)

The fact that the entire fuze body of the T59 Rocket is of plastic may be a factor contributing to the number of duds. (Test No. 10)

The modifications of the fuze striker appeared not to effect the stability of the T59 Rocket. (Test No. 10)

k. The T59 Rocket does not affect the M9A1 Launcher other than erode the tail latch. (Test No. 11)

The T59 Rocket will blow the breech collar off of the M9E2 Launcher in one to eight rounds when this launcher is used without modification. Reduction of the size of the tail latch prolongs the life of the launcher. (Test No. 11)

l. The propellant chamber of the T59 Rocket is not waterproof. (Test No. 12)

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m. One dud and two low order detonations were noted during the firing of 63 rounds of T59 Rocket. (Test No. 13)

WILLIAM S. SINCLAIR, JR.,
Major, Infantry,
Test Officer.

I concur in the above Record of Test:

WILLIAM C. RUTHERFORD,
Lt. Colonel, Infantry,
Chief of Test Section.

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OFFICE OF
THE INFANTRY BOARD

IB-471.9

Fort Benning, Georgia

1 June 1945

MEMORANDUM FOR: The Chief, Test Section, The Infantry Board.

SUBJECT: Rocket, High Velocity, 2.36". - Test.

1. The Supply Officer, T.I.B., has received a shipment of the subject material for service test by this Board.

2. These rockets have been designed as possible replacements for the present standard 2.36" Rockets, with a view to securing the following improvements:

a. Flatter trajectory and reduced time of flight (lead required) when used against moving targets.

b. Greater accuracy and greater effective range for point-blank firing against point targets.

c. Greater range, for high angle, mortar type of fire.

d. Greater armor penetration.

3. It is desired that your section conduct tests of the subject rocket along the lines followed in tests on previous models of the 2.36" rockets, as recorded in records of test on file, to determine to what extent the objectives stated above have been attained. Information should be obtained and recorded on the following additional points:

a. Stability and behavior in flight.

b. Approximate ratio between elevations required for the subject rocket at various ranges and those for the present standard rocket, with a view to preparing an approximate conversion chart for sight-setting required on the standard launcher sight when firing the subject ammunition.

c. Functioning of the propellant, as to:

(1) Ignition.

(2) Splintering and objectionable back-blast at high and low temperatures.

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APPENDIX "A"

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By NARA Date 9 Dec 22

(3) Amount of "recoil" induced by the subject ammunition in the two types of two-piece launchers now standard.

(4) Approximate formula for leading moving targets in mils per mile per hour in the lateral speed of the target, at whatever range is found to be the average, effective range of the rocket against point targets. For this purpose, the average velocity of the rocket in feet per second at the given range should be accepted as the basis for the formula, and applied to the speed of the target in feet per second (1.5 times the speed in miles per hour is the number of feet per second) and the resulting ratio, reduced to thousandths, should give the correct lead in mils per mile per hour. Thus, assuming that the average velocity of the rocket at the range chosen as the key or average range, is found to be 300 feet per second, the lead in mils per mile per hour would be 1.5/300, or 5/1000, or 5 mils per mile per hour in the lateral speed of the target. The correct figure will be determined by actual firing at moving targets whose speed is carefully regulated.

(5) Functioning of the fuze.

4. In case it should be found that the fuze fails to function on grazing impact with the ground when firing at flat angles, it is desired that the Design Section be requested to design and apply a flange for the front end of the fuze, of sufficient width to insure its contact with the ground before the shoulder of the ogive, and sufficient firing done with such appliance to determine whether:

a. It decreases the ratio of duds at the low angles.

b. It has any important effect on ballistics.

c. Interferes with the effect of the jet from the hollow charge on impact against armor.

5. This project has Priority "A", and will be expedited.

6. Col. Oseth is the Board Member charged with supervision of the project.

For the President:

/s/ JOHN C. BRINSMEAD,
JOHN C. BRINSMEAD,
Major, Infantry,
Recorder.

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APPENDIX "A"